

Notice of Allowability

Application No.

09/746,967

Applicant(s)

PULYER, YULY M.

Examiner

Tiffany A Fetzner

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 08/02/2004.
2. ☒ The allowed claim(s) is/are 1-19.
3. ☐ The drawings filed on _____ are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☐ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
 6. ☒ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☒ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☒ hereto or 2) ☐ to Paper No./Mail Date 08/02/2004.
 - (b) ☒ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date 09/30/2004.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08),
Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit
of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☒ Interview Summary (PTO-413),
Paper No./Mail Date 09/30/2004.
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____

Examiner's Amendment

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it **MUST** be submitted no later than the payment of the issue fee.
2. Authorization for this examiner's amendment was given in a telephone interview with **Attorney George W. Neuner Reg. No. 26,964** on September 30th 2004, along with authorization to charge any necessary fees to applicant's deposit account No. **04-1105**.
3. **Claims 1-8, 14, and 17-19** have been **examiner amended** as follows:

A) Replace claim 1 of the August 2nd 2004 amendment with the following **Examiner amended claim 1**:

Claim 1 --- A planar MRI system having:

(I) an open magnet configuration that produces a magnetic field having a remote region of substantial magnetic field homogeneity;

(II) spatial encoding gradient coils; and

(III) an RF coil;

the open magnet configuration comprising:

a ferromagnetic core having a substantially planar core surface layer and a longitudinal axis; and

a unipolar current wire pair adjacent said planar core surface layer, the wire pair being separated along said longitudinal axis on an one side of the ferromagnetic core, the wire pair extending in a direction substantially perpendicular to the axis and substantially parallel to the planar core surface layer,

the unipolar current wire pair providing a maximum magnetic field between the current wire pair along a direction perpendicular to said planar core surface layer and in said remote region of substantial magnetic field homogeneity,

the planar core surface layer of the ferromagnetic core providing an orthogonal ferrorefraction effect, which provides the effect of generating a set of mirror image current wires of the same polarity on the opposite side of the ferromagnetic core, that substantially increases the resulting magnetic field compared to a magnetic field generated by the unipolar current wire pair in free space. ---

B) Replace claim 2 of the August 2nd 2004 amendment with the following Examiner amended claim 2:

Claim 2 ---The MRI system of claim 1, wherein the ferromagnetic core comprises a plurality of layers of ferromagnetic material including said planar core surface layer, which is adjacent said current wire pair, said magnet configuration being constructed and configured such that the planar core surface layer operates near a magnetic saturation value of the ferromagnetic material forming the planar core surface layer. ---

C) Replace claim 3 of the August 2nd 2004 amendment with the following Examiner amended claim 3:

Claim 3 ---The MRI system of claim 2, wherein the planar core surface layer comprises a ferromagnetic material having a magnetic property including a Hsat value and the planar core surface layer operates within about 20% of the Hsat value. ---

D) Replace claim 4 of the August 2nd 2004 amendment with the following Examiner amended claim 4:

Claim 4 ---The MRI system of claim 2, wherein the planar core surface layer comprises a ferromagnetic material having a magnetic property including a Hsat value and the planar core surface layer operates within about 10% of the Hsat value. ---

E) Replace claim 5 of the August 2nd 2004 amendment with the following **Examiner amended claim 5**:

Claim 5 ---The MRI system of claim 2, wherein the planar core surface layer comprises a ferromagnetic material having a magnetic property including a Hsat value and the planar core surface layer operates within about 5% of the Hsat value. ---

F) Replace claim 6 of the August 2nd 2004 amendment with the following **Examiner amended claim 6**:

Claim 6 ---The MRI system of claim 2, wherein the planar core surface layer comprises a first ferromagnetic material and at least one of the layers comprises a second ferromagnetic material, wherein the first ferromagnetic material has a higher saturation induction and permeability than the second ferromagnetic material. ---

G) Replace claim 7 of the August 2nd 2004 amendment with the following **Examiner amended claim 7**:

Claim 7 ---The MRI system of claim 1, further comprising a ferromagnetic end extension extending from and out of the plane of said planar core surface layer, thereby providing an orthogonal ferrorefraction boundary effect, and wherein the end extension is positioned adjacent to, and longitudinally exterior of, one of the wires of the unipolar current wire pair. ---

H) Replace claim 8 of the August 2nd 2004 amendment with the following **Examiner amended claim 8**:

Claim 8 ---The MRI system of claim 7, wherein the ferromagnetic end extension comprises a plurality of layers of ferromagnetic material including an end extension surface layer that is adjacent a wire of said current wire pair, said magnet configuration being constructed and configured such that the end extension surface layer operates near a magnetic saturation value of the ferromagnetic material forming the end plate surface layer. ---

I) Replace claim 14 of the August 2nd 2004 amendment with the following **Examiner amended claim 14**:

Claim 14 ---The MRI system of claim 7, wherein the ferromagnetic end plate extends at an acute angle formed between the perpendicular to the planar core surface layer and the end plate in a direction toward the unipolar current wire pair. ---

J) Replace claim 17 of the August 2nd 2004 amendment with the following **Examiner amended claim 17**:

Claim 17 ---The MRI system of claim 16, further comprising a ferromagnetic shimming core having a planar shimming core surface layer adjacent to said shimming current wire pair. ---

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K) Replace claim 18 of the August 2nd 2004 amendment with the following
Examiner amended claim 18:

Claim 18 ---A planar MRI system having:

an open back to back magnet configuration that produces two independent magnetic fields, each having a remote region of substantial magnetic field homogeneity, the system further comprising

spatial encoding gradient coils; and

an RF coil for each remote region;

the open magnet configuration comprising:

a ferromagnetic core having a longitudinal axis, a first and a second side, each side having a substantially planar core surface layer; and

a unipolar current wire pair on each side of the ferromagnetic core adjacent said planar core surface layer, each wire pair being separated along said longitudinal axis on its respective side of the ferromagnetic core, each wire pair extending in a direction substantially perpendicular to the axis and substantially parallel to the planar core surface layer, wherein said unipolar current wire pair on each side of the ferromagnetic core are provided by a pair of current loops wound around the ferromagnetic core;

each unipolar current wire pair providing a maximum magnetic field between the current wire pair along a direction perpendicular to said planar core surface layer and in said remote region of substantial magnetic field homogeneity,

the planar core surface layer of the ferromagnetic core adjacent each current wire pair providing an orthogonal ferrorefraction effect, which provides the effect of generating a set of mirror image current wires of the same polarity on the opposite side of the ferromagnetic core, that substantially increases the resulting magnetic field compared to a magnetic field generated by the unipolar current wire pair in free space.

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L) Replace claim 19 of the August 2nd 2004 amendment with the following
Examiner amended claim 19:

Claim 19 ---A planar MRI system having:

(I) two face to face open magnet configurations that each produce a magnetic field having a remote region of substantial magnetic field homogeneity;

(II) spatial encoding gradient coils; and

(III) an RF coil;

wherein a first and a second open magnet configuration each comprise:

a ferromagnetic core having a substantially planar core surface layer and a longitudinal axis; and

a unipolar current wire pair adjacent said planar core surface layer, the wire pair being separated along said longitudinal axis on an one side of the ferromagnetic core, the wire pair extending in a direction substantially perpendicular to the axis and substantially parallel to the planar core surface layer,

the unipolar current wire pair providing a maximum magnetic field between the current wire pair along a direction perpendicular to said planar core surface layer and in said remote region of substantial magnetic field homogeneity,

the planar core surface layer of the ferromagnetic core providing an orthogonal ferrorefraction effect, which provides the effect of generating a set of mirror image current wires of the same polarity on the opposite side of the ferromagnetic core, that substantially increases the resulting magnetic field compared to a magnetic field generated by the unipolar current wire pair in free space,

wherein the remote region of substantial magnetic field homogeneity provided by a first open magnet configuration overlaps the remote region of substantial magnetic field homogeneity provided by a second open magnet configuration, thereby providing a total magnetic field equal to the sum of the remote regions provided by the first and the second open magnet configurations. ---

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4. The following **changes to the drawings** have been approved by the examiner and agreed upon by applicant:

M) Figures 7, 8a, 8b, 8c, 9a, 9b, 10a, 10b, 11a, and 11b shall be labeled as prior art. In order to avoid abandonment of the application, applicant must make these above agreed upon drawing changes.

Examiner's Comment

Drawings

5. A New set of corrected drawings are required in this application because the official draftsman has objected to the drawings submitted **July 7th 2003**. A **complete set of NEW FORMAL DRAWINGS** including any and all examiner approved drawing changes, (i.e. the **labeling of Figures 7, 8a, 8b, 8c, 9a, 9b, 10a, 10b, 11a, and 11b as prior art**) that have occurred during this examination are now required. [See the attached PTO 948 form of the Official Draftsman's Review.]

6. Applicant is advised to employ the services of a competent patent draftsman outside the Office, as the U.S. Patent and Trademark Office no longer prepares new drawings. The corrected drawings are required in reply to the Office action to avoid abandonment of the application. The requirement for corrected drawings will not be held in abeyance.

Response to Arguments

7. The applicant's arguments of the August 2nd 2004 amendment and response, have been fully considered by the examiner, and in view of the **examiner amendments to claims 1-8, 14, and 17-19** the arguments are persuasive. The examiner's amendments, are fully supported by applicant's original specification, [See page 7 lines 8-22], and were approved by the applicant's representative on September 30th 2004, in a telephonic interview with the examiner, were made to ensure that the argued position of applicant, is clearly recited in each of applicant's claims.

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8. The examiner agrees that the **prior art of record fails to teach or suggest** the applicant's combination of features taken together which include "the inventive novelty feature of a planar ferromagnetic core providing a substantial ferrorefraction effect which generates a set of mirror image current wires of the same polarity". The applicant's specification has original support for this feature on page 7 lines 8-22.

9. The examiner agrees that the **prior art of record fails to teach or suggest** "an orthogonal ferrorefractory effect" or that the magnetic field is produced "with parallel current wires using an orthogonal ferrorefraction boundary". [See page 11 paragraph 2 through page 13 paragraph 3 of the August 2nd 2004 amendment and response.

10. **With respect to the drawings** the examiner notes that applicant's open magnet configuration is a main point of novelty, of applicant's invention and that applicant's invention is used in combination with other known components, which include conventional spatial encoding gradient coils, and a conventional RF coil. **Applicant's Figures 7, 8a, 8b, 8c, 9a, 9b, 10a, 10b, 11a, and 11b** are **prior art**, configurations of conventional spatial encoding gradient coils, and conventional rf coils, which may be used with applicant's open magnet configuration as set forth in the recited claims, in order to comprise a fully functioning MRI system.

The following is an examiner's statement of **Reasons for Allowance**:

11. With respect to **Examiner Amended claims 1, 18, and 19** each of these claims are considered to be allowable over the **prior art of record** because the prior art of record does not disclose or suggest a planar MRI system comprising: "an open magnet configuration comprising: a ferromagnetic core having a substantially planar core surface layer and a longitudinal axis; and a unipolar current wire pair adjacent said planar core surface layer, the wire pair being separated along said longitudinal axis on an one side of the ferromagnetic core, the wire pair extending in a direction substantially perpendicular to the axis and substantially parallel to the planar core surface layer, the unipolar current wire pair providing a maximum magnetic field between the current wire pair along a direction perpendicular to said planar core surface layer and in said remote region of substantial magnetic field homogeneity, the planar core surface layer of the

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ferromagnetic core providing an orthogonal ferrorefraction effect, which provides the effect of generating a set of mirror image current wires of the same polarity on the opposite side of the ferromagnetic core, that substantially increases the resulting magnetic field compared to a magnetic field generated by the unipolar current wire pair in free space." in combination with the remaining limitations of each of the claims. **It is the combination of the claim limitations taken as a whole that constitutes both the novelty and non-obviousness of applicant's claims.**

12. With respect to **Examiner Amended claims 2-8, 14, 17 and dependent claims 9-13, 15, and 16** each of these claims are considered to be allowable over the **prior art of record** because they each depend from an allowable examiner amended independent claim.

13. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Prior art of Record

14. The **prior art made of record** and not relied upon is considered pertinent to applicant's disclosure.

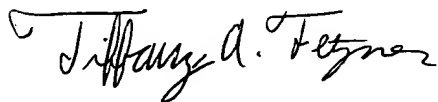
- A) **Pulyer** US patent 5,389,879 issued February 1995.
- B) **Crow** US patent 5,642,087 issued June 24th 1997.
- C) **Damadian** US patent 6,023,255 issued February 2000.
- D) **Pulyer** US patent 6,002,255 issued December 14th 1999.
- E) **Mallard et al.**, US patent 4,656,449 issued April 7th 1987.

Conclusion

15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tiffany Fetzner whose telephone number is: (571) 272-2241. The examiner can normally be reached on Monday-Thursday from 7:00am to 4:30pm., and on alternate Friday's from 7:00am to 3:30pm.

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16. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Diego Gutierrez, can be reached at (571) 272-2245. The **only official fax phone number** for the organization where this application or proceeding is assigned is **(703) 872-9306**.



TAF
September 30, 2004



Diego Gutierrez
Supervisory Patent Examiner
Technology Center 2800